VI. CABLE TELEPHONY BUSINESS CASE ANALYSIS

This section describes the model used to evaluate the business case for cable telephony. As in all network models, population density has a significant impact on cost per subscriber. Therefore, the section begins by selecting a hypothetical service area. A discussion of the architecture and associated technology that might be used by a cable operator to provide residential telephone service (cable telephony) in this service area follows. Cable telephony investment and expenses based on the network architecture assumptions are estimated next. This is followed by the demand and revenue assumptions. Finally, the revenue and cost information is used to develop the business case for this alternative local exchange telephone service.

A. Study Area

All of the counties in a group of seven states that have an average population density of between 850 and 2,550 households per square mile were examined.[28] Counties in this density range were selected for review because they are likely to be suburban and residential. These areas are among the best candidates for residential cable telephony services due to the economies of building cable plant in densely populated areas and the known demand for residential CATV service. Individual-county averages for several parameters were examined. Such parameters included: population density, distribution of the population throughout the county, and the location of population with respect to existing rights of way. Based on these averages, the county that most closely represented the average of the entire group was chosen for detailed

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[28] The states considered in this analysis are California, Colorado, New Jersey, New York, Ohio, Tennessee and Texas. A limited number of states was chosen as a practical matter. These states were selected in an effort to sample a wide range of demographic data.

analysis. The selected county contains approximately 580,000 households on a total land area of 465 square miles; hence the average population density across the study area is roughly 1,250 households per square mile.

Most urban areas of the size and density of the selected study area are served by multiple cable companies. These companies serve separate portions of large geographic areas and do not compete with each other. Few, if any, cable operators actually serve a contiguous area as large as the one considered in this analysis. Nevertheless, this analysis assumes that the entire study area is served by a single cable operator. This assumption represents a best case scenario for cable telephony because marketing and operational economies will be achieved as a result of the wide area of contiguous coverage.

B. The Cable Television Network Upgrade Model

The cost of adding the capability to provide telephone service to a cable network depends to a large extent on the state of the existing cable network. Traditional cable architecture is incompatible with telephony because cascading chains of amplifiers in the distribution network make two-way communication impossible. This situation describes many existing cable networks. Such networks would have to be completely rebuilt, or at least extensively overhauled, in order to provide an acceptable platform for the addition of telephony capability.

A cable network newly constructed or rebuilt within the past 5-10 years may have replaced the coaxial cable in portions of the network with fiber optics in order to enhance cable quality, improve reliability and increase capacity. Such a network is referred to as "fiber-rich" or "fiber-to-the-node." A brand new cable system may be constructed with a hybrid fiber/coax

(HFC) network architecture capable of supporting two-way communication. This new system would have little need for additional network upgrades to make the cable plant telephony-ready.

This analysis will develop a business case for cable telephony under two scenarios. In the first scenario, the cable operator has built a modern HFC system and is contemplating adding the capability of providing local telephone service. In this case, none of the cost of the HFC network upgrade is attributed to the decision to provide telephone service. In the second scenario, the operator must upgrade its existing fiber-rich cable system to a full HFC network before it can consider competing in the local exchange telephone business. It is assumed that the fiber-rich network is adequate for all current and foreseeable cable services.[29]

A situation in which the cable operator must completely rebuild an antiquated system that is based on traditional tree and branch architecture and does not contain any fiber is a possible third scenario. However, this situation is analytically equivalent to the second scenario.[30] A cable operator with an antiquated system may well upgrade to a fiber-rich network for the provision of CATV service alone.[31] Therefore, a fiber-rich network might be a reasonable starting point for determining the costs of a network upgrade needed to provide telephony services, even if the existing system is antiquated.

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[29] Set-top upgrades in such a system allow cable capacity expansion through the use of digital compression techniques. See Geraldine Fabrikant and Mark Landler, "A Cable Giant Loses its Way and Finds Recovery Difficult," New York Times (December 9, 1996), p. C8.

[30] There are, however, obvious differences for timing, capital considerations, etc. As a result, entry into the cable telephony business may be delayed in areas with antiquated systems.

[31] The benefits of fiber-rich CATV networks for the delivery of television programming are well known. Operational savings and better picture quality are among the reasons fiber-rich networks are superior to traditional tree and branch systems.

This analysis will conservatively assume that none of the cost of upgrading an antiquated system to a fiber-rich network is caused by the decision to provide telephony. In some cases, the decision to rebuild or upgrade an antiquated system may be driven by, or at least substantially affected by, the decision to provide telephone service. If the non-modernized (antiquated) network is capable of providing all the cable services the operator desires to provide, then the full cost of the network rebuild or upgrade would be caused by the decision to provide telephone service. In instances where this scenario does apply, the business case for the cable operator contemplating the investment in cable telephony would be significantly worse than the one presented in this report.[32]

Industry estimates of the state of cable television network modernization vary widely. The HFC network discussed in this report is assumed to be a 750 MHz two-way active system.[33] Sources report that between 10 and 37 percent of the cable networks of the largest systems are HFC systems that are capable of supporting incremental telephony investments.[34] This is not to

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[32] Recent announcements indicate that TCI is changing its plan to completely modernize CATV networks. Instead, TCI plans to invest in digital equipment that will increase channel capacity. In such a case, a decision to provide cable telephony service would require that the entire network upgrade/rebuild cost must be allocated to telephony. See Fabrikant and Landler, *supra.*, note 29.

[33] A two-way active cable system is capable of transmitting signals in two directions -- from the headend or fiber hub to a subscriber premises (downstream) and from a subscriber premises to a headend or fiber hub (upstream). Traditional cable systems were designed only for the broadcast delivery (downstream) of video signals and do not support two-way communications. Since telephone conversations always require upstream and downstream transmission of signals (i.e., talking and listening), a two-way active cable network is a requirement of any cable operator wishing to offer cable telephony service.

[34] See Rich Brown and Richard Tedesco, "Cables Recurring Dilemma: Promise v. Performance," Broadcasting and Cable (April 29, 1996), p. 12. A 1995 Report estimated that

say that 10 to 37 percent of all cable television networks are currently serving as local telephone loops; rather, the point is that cable networks passing as many as 10 to 37 percent of homes served by large systems could support incremental telephony investments without substantial changes to the transmission facilities in the cable network.[35]

The following sections describe the steps necessary to upgrade a fiber-rich system to an HFC system capable of serving as a platform for cable telephony. At the highest level, a modernized cable system consists of three basic parts: distribution plant, feeder facilities and supertrunks.[36] Distribution facilities comprise the "last mile" portion of the network and serve each premises via a subscriber drop. Even a fiber-rich system may continue to use traditional one-way coaxial distribution facilities. The feeder portion of a fiber-rich network is optical and carries traffic between fiber hub locations and distribution facilities. The point where feeder hands off to distribution facilities is referred to as an optical node. Supertrunks are used, where necessary, to provide a link between the headend and fiber hub locations. Figures 1 through 3 give an overall view of the modeled HFC network structure in an increasing level of detail.[37]

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large capacity systems accounted for only 15 percent of total cable plant miles. See, Walter S. Ciciora, Cable Television in the United States (1995), p. 22.

[35] Although some of the larger cable operators are upgrading plant and enabling the upstream portion of their networks, such upgrades may not be universal throughout the cable industry. At the end of 1995, General Instruments reported that only 3 to 4 percent of the U.S. cable plant is two-way active. See, Paula Bernier, "GI Introduces One-Way Cable Modem," Inter@ctive Week (December 5, 1995).

[36] In this report, feeder facilities are the modern equivalent of traditional CATV trunk plant.

[37] An upgrade is defined as a plant rehabilitation process that results in the exchange or modification of amplifiers and passive devices (such as line splitters, directional couplers, and customer multitaps). See Ciciora, *supra.*, note 34. This definition describes the distribution

1. Supertrunk Facilities

Supertrunk facilities are typically used by large cable operators that serve multiple communities in a metropolitan area. Traditional cable supertrunks often consist of microwave links, satellite feeds, and sometimes telephone circuits. This architecture suffers from the same shortcoming as most cable television plant; it is designed for the broadcast delivery of television signals and lacks the ability to send signals in two directions. Even modernized fiber-rich systems generally use such a supertrunk architecture.

In contrast, modern upgraded supertrunk facilities generally employ fiber optic ring systems that provide communications between the headend and a number of remote headends or fiber hubs. Two-way supertrunks provide the ability to transmit and receive telephone conversations, broadband data communications, and any other information that may be required in an interactive environment between the headend and the remote headends or fiber hubs. Further advantages of these systems are route diversity and the avoidance of interference that can be a problem in microwave systems.

Modern cable network upgrades often employ the concept of a centralized headend serving multiple fiber hubs through a fiber ring network. Consolidating all the traffic in a single location allows cable operators to, for example, provide all telephony switching from one headend, or serves as a single point of interconnection between the cable operator's broadband data communications network and the Internet. As a result, in this analysis, the additional cost of upgrading supertrunk facilities is included in the cost estimate for upgrading a fiber-rich

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plant facilities considered in the estimation of costs associated with upgrading a system from a fiber-rich to a full HFC network.

system to HFC. The supertrunk upgrade model used in the business case analysis assumes six fibers for analog video, six fibers for telephony, and six fibers for each fiber hub on the network, which can be used as the basis for future services. For example, a ring serving four fiber hubs and a headend would contain a total of 36 fiber strands.

In the supertrunk network that was modeled for this study, the headend and fiber hubs are located near existing telephone company wire center locations. This assumption strategically locates these buildings in the middle of population centers and along existing telephone company rights of way.[38] Furthermore, wire centers generally serve between 10K and 30K households, which is in the range of a typical fiber hub size. A high level view of the supertrunk architecture is depicted in Figure 1.

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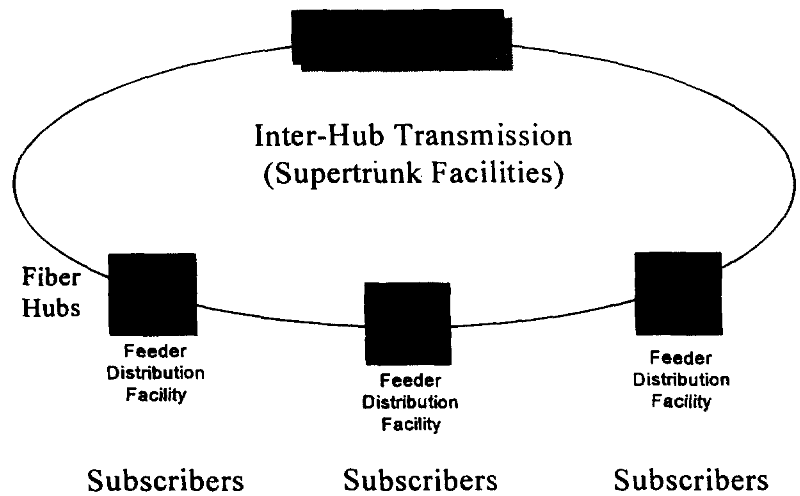
[38] According to Bellcore, its client companies have an opportunity to provide video transport to cable operators based on the positioning of existing wire center locations, stating that "these opportunities take advantage of the strategic positioning of central office buildings within population centers and the convenient access they provide to conduit and pole line structural networks." Bellcore, A Compilation of Results from Recent Bellcore Studies on Fiber to the Home (FTTH), special report SR-TSY-001468, Issue 1 (December 1989), p.16.

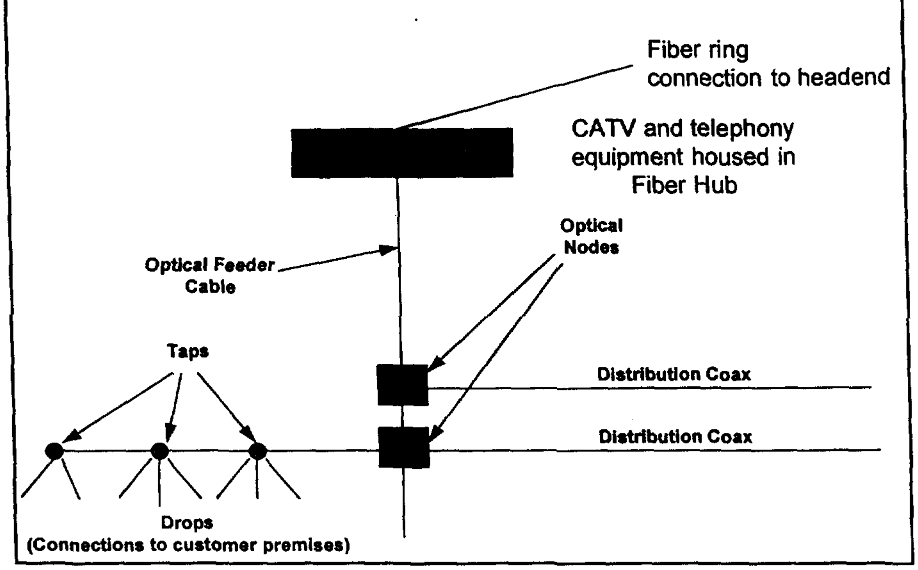
Figure 1
HFC Network Structure



2. Feeder Facilities

Feeder facilities consist of fiber optic cabling between the fiber hub and the optical node. This analysis assumes that the starting point for the cable operator considering the provision of telephony is minimally a fiber-rich system. Therefore, no additional costs for the feeder portion of the HFC network are included in the cost estimate for upgrading a fiber-rich system to two-way active HFC. The number of households served per optical node (fiber penetration) would have been determined by the cable operator at the time the fiber-rich network was installed. This analysis assumes that fiber penetration for all scenarios is at least to the 2,000 homes passed level. By assuming no more than 2,000 households per node, the cable telephony system presented in this analysis can accommodate an ultimate telephony penetration of 30 percent.[39] A diagram of feeder facilities is shown in Figure 2.

Figure 2
HFC Distribution Network Structure



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[39] Although emerging cable telephony systems typically require fiber deployment to the 500 home level, not the 2,000 home level, this model conservatively uses a 2,000 home per node fiber penetration in the estimation of network upgrade costs. To this end, this analysis assumed forward-looking cable telephony technologies with bandwidth efficiency and noise resistance that is superior to that of most current cable telephony systems. Making this assumption allows the modeled cable telephony system to cover a 30 percent telephone penetration in a 2,000 home passed per node network. There are several reasons why 500 homes passed per node penetration levels may be preferred by a cable operator. First, bandwidth utilization based on older (but most common) QPSK cable telephony technology may require deeper fiber penetration to adequately serve all telephone subscribers requesting cable telephony service. Second, services such as broadband data, may require upstream bandwidth. Additional reasons include reduced opportunities for interference, smaller failure group sizes (i.e., 500 homes lose service instead of 2,000) and greater reliability in the network due to the reduced number of active elements along any given path in the distribution network.

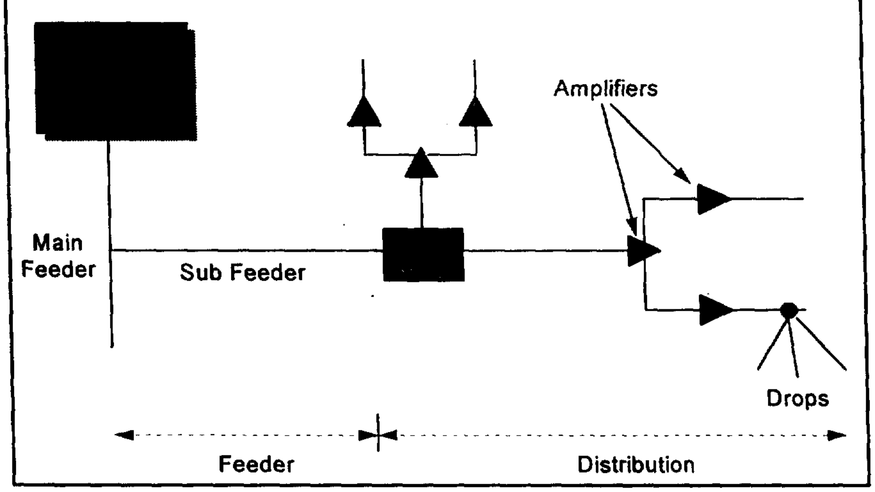
For additional information on HFC network reliability, see: Network Reliability Council (NRC), Reliability Issues - Changing Technologies Focus Group - New Wireline Access Technologies Subteam Final Report (February 22, 1996).

3. Distribution Facilities

Distribution facilities generally consist of the coaxial cable network between the optical node and customer premises. Thus, even in a fiber-rich network, modifications must be made to distribution facilities before it would be possible to provide telephony. In estimating the cost of these modifications, this analysis conservatively assumes that all existing coaxial distribution and drop cabling can be salvaged. As a result, only the cost of two-way amplifiers, power passing taps, connectors, splices, power supplies incremental to telephony, installation and the like are considered.

Distribution distances are computed based on the total land area served and the density of households in the served area. The distribution distance is proportional to the total area served and inversely proportional to the population density. The distribution network model is depicted in Figure 3.

Figure 3
Details of Distribution Network Structure



The power supplies in the distribution network are sized with adequate capacity to power the active elements on the distribution network and customer premises equipment for telephony. Power supplies for telephony were sized assuming a maximum telephony penetration of 30 percent.[40] The telephony equipment is powered through the HFC network. This architecture was selected because it appears to be the most preferable option available to cable operators. Network powering of cable telephony equipment is desirable because it does not require intrusive or costly maintenance at each subscriber premises. Furthermore, it results in a system that most nearly approximates that of the incumbent local exchange carriers (ILECs), which is a necessity for cable operators if cable telephony is to be viewed as a true replacement of existing local exchange services.[41] The incremental cost of adding power for telephony is assumed to be 20 dollars per home passed in the service area.[42]

4. HFC Network Upgrade Model Results

As noted above, the network upgrade model was run with a penetration level of 2,000 homes passed per node. The 500 homes passed per node case was also modeled for comparison purposes because it is generally considered the standard node penetration required for efficient HFC upgrades. In fact, the majority of systems already upgraded, or currently under

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[40] Engineering power supplies for a cable telephony system generally require an up-front estimation of the ultimate penetration level. See, James Careless, "The Five Big Headaches of Cable Telephony," Communications Engineering & Design (October, 1996), p.74.

[41] This analysis assumes decentralized power in the distribution network. The decentralized power supplies serve the distribution network active elements and the CIUs located at the customer premises.

[42] Careless, *supra.*, note 40.

construction, are built to this level.[43] However, even at the 2,000 home per node level of penetration, the cable telephony system examined in the business case analysis is fully capable of supporting primary and secondary line service at a take rate of 30 percent of homes passed.

The following investment numbers assume an upgrade to HFC from an existing fiber-rich network and penetration levels of either 500 or 2,000 homes passed per node.

Table V

Penetration	Per Passing	Per CATV Subscriber
500 HH/node, upgrade	$113	$154
2,000 HH/node, upgrade	$108	$148

There is only a slight difference in upgrade cost between the 500 and 2,000 homes passed per node cases. Deploying feeder fiber to the 500 home level is considerably more costly on a homes passed per node basis than deploying fiber to the 2,000 home level. The numbers shown in the table above reflect only the cost of upgrading supertrunk and distribution plant to HFC. The assumption is that the amount of distribution plant is roughly the same in both the 500 and 2,000 household per node cases.[44]

As noted above, this analysis assumes that a complete rebuild from an older cable system architecture is not required for telephony. If an upgrade is required for telephony, but is not

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[43] Rich Brown and Richard Tedesco, "Cable's Recurring Dilemma: Promise vs. Performance,"*supra.*, note 34, p.12.

[44] In large metropolitan areas like the one considered in this analysis, the assumption is that distribution plant mileage remains constant for a given number of homes passed, regardless of node penetration.

necessary for the cable company to retain its cable business, then the cost of the upgrade is incremental to telephony. If the upgrade would have been undertaken even in the absence of telephony plans, then the cost of the upgrade is not incremental to telephony. The most likely case is that the upgrade benefits both the cable and the potential telephony business and would not be undertaken solely for either of the services. In this case, it would be appropriate to place some portion of the cost of the upgrade in the telephony business case.[45]

C. Cable Telephony Investment and Expenses

The following sections describe the investment and expenses required to provide telephony over an upgraded cable system. Subsection 1 below describes the investment required to enable telephony services over a two-way active HFC system. Subsection 2 discusses the expenses that will be incurred in providing service, including operation, maintenance and marketing. The business case results are discussed in Section D.

1. Cable Telephony Architecture

The cable telephony system that is considered in this business case analysis requires modernized cable plant (i.e., a two-way active HFC network). Technologically, the telephony over cable system works in the following way. Telephone conversations are carried over the HFC network by digitizing a user's voice signal and multiplexing it onto one or more of the existing frequency bands in which standard television signals are normally carried. Electronic

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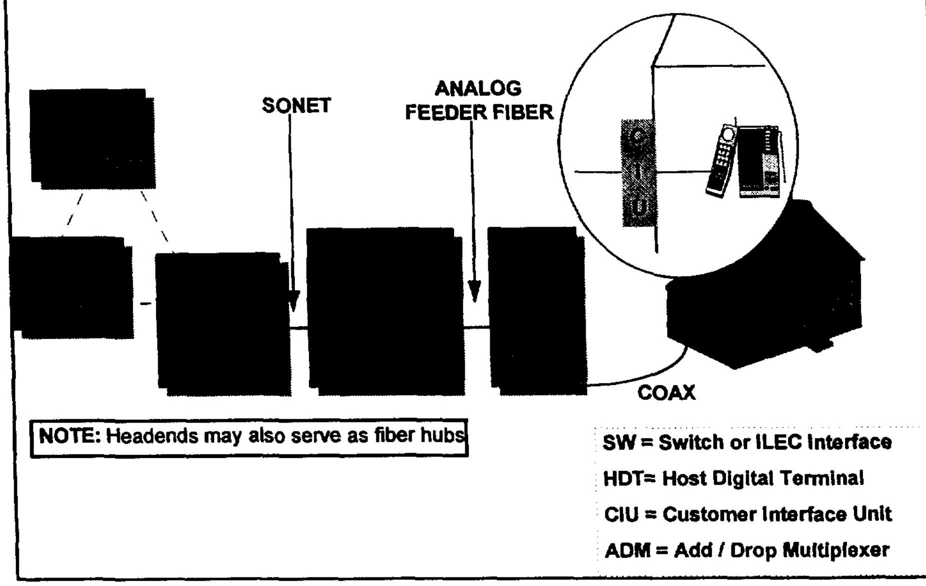
[45] The assumption that none of the HFC network upgrade or rebuild costs are allocated to telephony is conservative in light of a recent cable industry announcement that states "TCI's telephony and Internet services divisions will also have to underwrite the costs associated with any future two-way plant upgrades." See, "Will TCI Budget Cuts Hit Telephony, Data Services?," Multichannel News (November 11, 1996).

equipment supporting telephony over the cable network, which would usually be located in the headend, reformats the digitized voice so it can interface with exchange switching equipment via normal telephone circuits, with associated signaling.[46] From the perspective of both the switch and the subscriber premises, the cable system provides a transparent replacement for the existing local exchange carrier subscriber loop.

The cable telephony system that was modeled in the business case analysis is depicted in Figure 4. The basic components are a customer interface unit (CIU), a telephony interface unit, or host digital terminal (HDT) located at the fiber hub or headend, and backhaul multiplexing equipment. Between the fiber hub and customer premises, the HDT and CIU communicate through the HFC network. The network side of the CIU connects to the coaxial distribution cable at the subscriber drop. On the customer premises side of the CIU, coaxial cable is used for provision of normal television service, and two copper telephone lines are tied into existing premises telephone wiring to provide telephony services.

[46] The exchange switch may be owned by the cable telephony provider or purchased as an unbundled element from an ILEC.

Figure 4
Cable Telephony Architecture



Customer interface units must be powered. The power is used to run the modems that transceive signals to/from the HDT and to generate the ringing/talking voltages that are required by subscriber telephone sets and premises equipment. This analysis assumes that the subscriber unit is powered from the network, and therefore requires no connection to the subscriber's electrical power. The system considered in this analysis offers 360 simultaneous voice conversations in 6 MHz of bandwidth, with additional lines added in 0.5 MHz, or 30 line, increments.[47]

[47] With 12 MHz of bandwidth in both the upstream and downstream frequency bands, such a system will support 720 simultaneous conversations. Therefore, this system could support a 30 percent telephony penetration in a 2,000 homes passed per node network. This is a conservative assumption based on forward-looking cable telephony technology. The majority of

The CIU is an incremental expense of telephony. When a new subscriber orders telephone service, a technician must physically install the CIU at the customer premises. No subscriber receives a CIU until telephone service is ordered. Therefore, the CIU electronics and installation costs are treated as customer acquisition expenses. In the analysis, these costs are considered to be $363 and $50, respectively, for a two-line unit. The HDT is also considered an acquisition expense, because it is essentially incremental to telephony as capacity can be added in 30-line increments. Therefore, we assume that additional HDT capacity will be added at roughly the same time as telephony subscribers. Moreover, treating the HDT as an incremental cost is more conservative than building unused capacity. The incremental expense of HDT electronics and installation are $150 and $15 per line, respectively. The analysis assumes that cable telephony penetration will increase throughout the entire ten-year analysis period. Therefore, the CIU and HDT equipment costs are reduced 5 percent annually to account for equipment price reductions over time.

Telephony signals are carried from the customer premises to the HDT (upstream) in the 5 to 40 MHz frequency range.[48] When these telephony signals arrive at the fiber hub, they are demodulated and repackaged as digital telephony streams that meet applicable Bellcore switch interface specifications. If the switch is not local, i.e., it is not located in the fiber hub or

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cable telephony electronic devices either available or in trial today would support roughly 100 simultaneous conversations in 6 MHz of spectrum.

[48] Until recently, the 5 to 40 MHz range was generally unused spectrum on most cable systems. Today, this return path might be shared by telephony systems, cable modems and other full service network traffic.

headend, the digital telephony streams are backhauled to the switch interface through interoffice facilities.

The switches, or trunks, to a third-party switching provider are concentrated in the headend. As a result, it is generally necessary to backhaul telephony traffic from the fiber hub (where the HDTs are located) to the headend. In this case, backhaul multiplexing is treated as an incremental expense associated with each new telephony line added. The incremental investment in backhaul multiplexing is estimated to be approximately $30 per line, based on the cost of OC-3 electronic equipment.

2. Cable Telephony Service Expenses

A cable telephony operator would incur recurring expenses to operate and maintain its telephone equipment, to service customer accounts and to market its service. In general, the analysis assumes that these expenses would be equivalent to those incurred by telephone companies for similar activities. In many cases, expense factors are from the Hatfield Model, Version 3.1.[49] This analysis considers the following expenses:

ILEC Interconnection Expense Bill and keep is assumed. Under bill and keep interconnection agreements, carriers terminate each others' traffic without charge. It can be reasonably assumed that traffic will be in balance and that the terminating charges of ILECs and cable telephony companies will be comparable, even if bill and keep were not used.

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[49] See, Hatfield Model, *supra.*, note 23.

Usage Sensitive Switching Expense $.00144 per minute of use was assumed, based on the Hatfield Model usage sensitive switching cost. This value is an acceptable proxy for in-house or outsourced switching.

Fixed Switching Expense (port cost) Based on the Hatfield Model port cost estimate, a $.92 per line, per month fixed switching expense was assumed. Again, this value is an acceptable proxy for in-house or outsourced switching. It is also a conservative estimate, because the number is based on the economies associated with large switching systems.

Plant-Specific Network Expenses An historical RBOC expense factor for central office equipment is applied to the total investment in HDTs, CIUs, and backhaul multiplexing equipment. The central office equipment factor is .0172. It is assumed that there are no additional network maintenance expenses incremental to telephony.

Building Expense The assumption is that no additional building space is required for telephony.

Network Operations Expense Providing cable telephony services will result in substantial incremental power, testing, operation, engineering, and network administration expenses. These functions are much simpler for a cable-only system. The Hatfield Model estimates a forward-looking network operation expense for telephone companies based on historical experience. The portion of this factor associated with the loop unbundled network element ($1.33 per line per month) is used here.

Network Support Expense The network support category includes expenses associated with items such as motor vehicles, aircraft, special purpose vehicles, garage and other work equipment. The assumption is that all such expenses would be incurred to support traditional cable services and are therefore not incremental to telephony.

Billing, Billing Inquiry, and Directory Expense The Hatfield Model billing and billing inquiry expense of $1.22 per line, per month is assumed. Similarly, the Hatfield Model value of $.15 per line, per month directory listing expense is used.

Local Number Portability Expense The Hatfield Model local number portability expense of $.25 per line per month is used.

Uncollectible Expense The historical RBOC uncollectible expense factor of 1.16 percent is used.

Other Taxes Expense This expense category includes operating taxes such as property, gross receipts and franchise fees. A 5 percent other tax expense factor is applied to the total cable telephony revenues to estimate the annual other tax requirement.

Overhead Expense As in the Hatfield Model, variable overhead expenses are associated with the size of the firm through a gross-up on expenses. The overhead expenses include a $1.10 per line loop overhead expense plus a 10.4 percent gross-up of the total cable telephony expenses.[50]

Marketing Expenses Product management, sales and advertising expenses are likely to be substantial for a new entrant into the telephony business. The 1994-1995 common carrier statistics published by the FCC were used to determine the RBOC annual per line expense

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[50] The per line equivalent loop overhead expense was computed as 10.4 percent of the monthly loop cost produced by the Hatfield Model for the cable telephony study area. See, Hatfield Model, *id.*

associated with product management and sales (i.e., the computed per line product management and sales expense for the RBOCs is $20.60 per year). These per line expenses were multiplied by the annual average subscribers in each year of the cable telephony business case analysis to estimate the product management and sales expense that might be encountered by a cable telephony provider.

Since advertising expenses are usually a function of the overall market size of the area to be served, historical RBOC data are used to determine an annual per household advertising expense. The computed RBOC advertising expense is $5.98 per household in the serving area, per year. Adjusting this value for the fact that it represents both residential and business advertising expense yields a total residential advertising expense of $2.60 per household per year. This advertising expense is applied to the business case analysis by multiplying total households in the modeled study area times the average residential advertising expense of $2.60.

Using historical RBOC expenses as a proxy for the marketing and advertising expenses that might be incurred by a cable telephony provider is extremely conservative. First, the RBOCs have not required extensive marketing of monopoly local exchange service. In addition, studies indicate that consumers are generally satisfied with the quality and reliability of their existing local exchange service (i.e., there is no pent-up demand for new or better local exchange service).[51] Furthermore, compared to cable companies, the RBOCs generally have a good customer image. As a result, a cable operator wishing to compete with an incumbent local

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[51] A recent Yankee Group study found that only 4.8 percent of current ILEC subscribers would switch to cable telephony at current ILEC price levels. See "Drawing the Battle Lines," Wall Street Journal (September 16, 1996), p. R4.

exchange for telephone service will be forced to use significant financial resources to improve its image and convince satisfied POTS customers to switch local exchange service providers.

D. Demand and Revenue Assumptions

A cable telephony operator has five primary sources of revenue: the monthly service charge for local exchange service, second line service fees, access fees charged to interexchange carriers ("IXCs"), net long distance resale and vertical features such as custom calling. Total telephone penetration in the service area is a function of the number of households and the take rate for second lines. The number of households subscribing to a second line is 8 percent at the beginning of the study period, increasing linearly to 17 percent by the end.[52] The number of households in the study area is assumed to grow by 1.7 percent per year.[53]

Subscriber churn is included. A lower churn figure than the standard 2 percent per month cited for cellular is assumed. The model uses .5 percent per month. Furthermore, the model assumes 75 percent of the CIUs are recovered from subscribers discontinuing service. These CIUs are recycled and represent an avoided cost in acquiring subsequent subscribers.

The model assumes that the average subscriber uses $5.23 worth of vertical services per month.[54] The price of these features falls linearly to $1.00 by the fifth year of the study.[55] These

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[52] Derived from MTA-EMCI, U.S. Competitive local Loop Market: 1996 (May 1996), p. 133.

[53] Computed average annual growth rate over a 19 year period, 1995 Statistical Abstract of the United States, p. 57.

[54] This is the current average per line revenue from account 5060, other local exchange revenue, for all RBOCs. See Common Carrier Statistics, *supra.*, note 19, p. 41.

[55] Telephone company studies show the incremental cost of these features to be quite small.

services are currently priced well above cost by telephone operators. Competition would drive these prices to cost.

The business case assumes that the cable company is in the long distance resale business and that 50 percent of the cable telephony customers purchase resold long distance customers from the cable telephony operator. Access and resold long distance minutes are assumed to grow by 7 percent per year throughout the study period.[56] The margin on long distance resale is assumed to be $.015 per minute.[57]

Monthly service charge revenues are based on the national average rate of $19.00.[58] This amount was not discounted even though a recent Yankee Group study found that local service charge discounts of 10-15 percent are required in order for cable operators to attract 21.5 percent of current ILEC local exchange subscribers.[59]

The current national average access charge is approximately 3 cents per minute.[60] This amount is used to determine year one access revenue. The FCC is currently considering access

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[56] See FCC, Trends in Telephone Service (May, 1996).

[57] IXCs are advertising residential long distance calling plans with rates between $.10 and $.15 per minute. The margin used in this analysis is a function of three parameters: an assumed average residential retail long distance rate of $.125, an SG&A expense of 17 percent of revenue, and long distance minutes purchased from a carrier at a rate of $.09 per minute. See, Merrill Lynch, U.S. Telecom Services -- Long Distance -- Third Quarter Review (November 13, 1996), p.11.

[58] In October 1994, the national average for flat-rate residential service was $19.00 monthly, including taxes and subscriber line charges. See Trends in Telephone Service, *supra.*, note 56.

[59] See, The Wall Street Journal, *supra.*, note 51. Furthermore, this is consistent with *ELB-I* survey results. See, The Enduring Local Bottleneck, *supra.*, note 4, p. 110.

[60] See, Trends in Telephone Service, *supra.*, note 56.

charge reform proposals that would bring access charges to cost.[61] The business case assumes that by the fifth year of the study period, access charges will be priced at the TSLRIC cost estimated in the Hatfield Model.[62]

As discussed in Section V, the modeling focuses on residential competition. It may be possible for cable operators to attract businesses in the territories they serve to use cable telephony. Businesses pay relatively more for basic telephone service than residential customers and tend to use more long distance services per line. This would add substantial revenues to the telephony business case. However, the business case results discussed below would not necessarily change. First, like residential rates, business rates could be expected to fall to cost over time. Second, serving business customers would involve investment in drops and would likely involve substantial additional infrastructure construction.

Cable telephony penetration will depend on a number of factors including cable company pricing policy, ILEC pricing, marketing effort, and consumer willingness to change suppliers at various price levels. We have computed the business case for cable telephony under three alternative end of period penetration assumptions: 10, 20 and 30 percent. It took competitive long distance companies 10 years to achieve a 30 percent penetration after the introduction of

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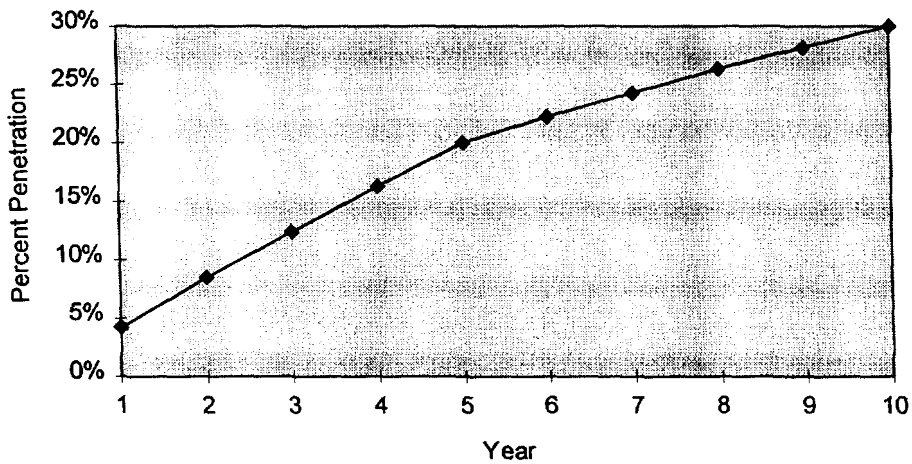
[61] See, In the Matter of Access Charge Reform, Notice of Proposed Rulemaking, CC Docket No. 96-262, released December 24, 1996.

[62] Some access charge reform proposals contemplate rebalancing that would increase the monthly local exchange service per line rate. Line rates are not increased in the business case as access charge prices are reduced. When embedded advertising, marketing and product management costs are added to the Hatfield TSLRIC rate for the study area, the resulting cost is close to the existing national average residential monthly service charge, suggesting that ILECs can recover their economic costs without rebalancing.

switched competition, despite substantial price discounts and a ballot and allocation process in the early years of competition.[63]

The rate at which the ultimate penetration is achieved has a substantial effect on the business case results; achieving penetration more rapidly improves the business case. Instead of assuming a linear growth in penetration over the ten-year study period, an optimistic assumption is made that two-thirds of the ultimate penetration is achieved after five years. Figure 5 illustrates the penetration growth assumption for the 30 percent penetration case.

Figure 5
Cable Telephony Subscriber Penetration



Current cable telephony penetration in the U.K. ranges between 20 and 30 percent after six years of competition.[64] However, the cable telephony experience in Great Britain cannot be

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[63] See Common Carrier Statistics, *supra.*, note 19.

[64] See John Cluny, "Cable Telephony as a Business," unpublished manuscript, presented at 1996 Telecommunications Policy Research Conference.

used as a template for the U.S. market. First, cable operators in Great Britain were able to install wires for telephony at a very low incremental cost because very little cable service existed prior to 1991. Second, in 1990, British Telecom ("BT"), the incumbent carrier, may have still been suffering from its government monopoly legacy.[65] While BT's performance has improved markedly in recent years, cable competitors had a window of opportunity to exploit. As noted above, U.S. cable operators are faced with generally satisfied local telephone service customers and poor customer service reputations of their own. Finally, cable penetration in the UK has not come cheaply.[66] It is not clear that investors in U.S. Cable properties will be so tolerant to these start-up losses.[67]

E. Business Case Results

Three penetration scenarios that range from pessimistic to optimistic are considered in the business case. The parameters that change between scenarios are the tenth-year cable telephony penetration rate, the incremental investment in a two-way active network and long distance usage levels.

New entrants may successfully market to higher than average long distance users in order to maximize revenue. Therefore, a sensitivity analysis on long distance usage is conducted. The sensitivity consists of evaluating the business analysis for two long distance usage levels: average long distance usage and twice the average long distance usage per customer.

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[65] See Lawrence Chimerine and Erik R. Olbeter, Lessons From Abroad: Deregulation Efforts in New Zealand and the United Kingdom (July 1995), p. 27.

[66] See Merrill Lynch, Telewest (January 17, 1997), p. 13.

[67] For a detailed description of cable telephony in the U.K., see, Cluny, *supra*, note 64.